

# **Information seeking behavior of Greek astronomers**

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## **Abstract**

This study examines three aspects of information seeking behaviour of astronomers in Greece including a) the importance they place in keeping up-to-date with current developments b) the methods they depend on for keeping up-to-date and c) the information sources they mostly use.

We adopted an intradisciplinary approach in order to investigate similarities and differences in information seeking behaviour among astronomers when examining them as groups bearing different characteristics, including academic status, subfield-research area of astronomy, age, and affiliated institution.

The analysis of our results a) revealed that although some similarities exist, there are significant variations in the behaviour of the different groups of our participants, and b) highlighted the need for deeper investigation of narrower subject communities within disciplines in order to acquire deeper understanding of their information seeking behavior.

*Keywords: Information seeking behaviour, User studies.*

## **Introduction**

Information seeking behavior studies have always been of the main concerns of librarians and information scientists. According to Wilson (2000) «Information Seeking Behaviour is the purposive seeking for information as a consequence of a need to satisfy some goal», and its «origins are found in work on the users of libraries and in readership studies in general».

Such studies aim at the evaluation of information collections (Broadus, 1980), or the maximization of the efficiency of information services provided, specific to the field of study (Ellis, 1993; Kuhlthau, 1993; Marchionini, 1995). Furthermore, the study of the information behaviour or habits of specific communities help detect users' habits and needs, hence making it possible to introduce the necessary instruction programs in information literacy, responding effectively to those communities' requirements (Hepworth, M and Wema, E., 2006; Pinto, María and Sales, Dora 2007; Walker, J. R., Moen, William E., 2001).

Our area of study is the research related to information seeking behavior of astronomers. The last of the statements in the paragraph above, that is the information literacy programs, constitutes the main aim of our study. Moreover, we favor the concept of the domain-analytic paradigm in information science, which states that «the best way to understand information in IS, is to study the knowledge-domains as thought or discourse communities, which are parts of society's division of labor» (Hjørland 1995). Accordingly, we narrowed our research focus on astronomers, and

particularly on Greek astronomers of the area of Athens, for in depth domain study and we detected their habits and needs in order to introduce an information literacy program appropriate for their requirements.

This article presents part of the findings of the survey study which constitutes the first step of a PhD thesis. The main aim of this particular work is to examine three aspects of information seeking behaviour of Greek astronomers including a) the importance they place in keeping up-to-date with current developments b) the methods they depend on for keeping up-to-date and c) the information sources they mostly use. Furthermore, the study also uses an intradisciplinary approach in order to investigate similarities and differences in information seeking behaviour among astronomers with different characteristics, including academic status, subfield-research area of astronomy, age, and affiliated institution.

### **Literature review**

Unfortunately, there is not much bibliography concerning the information seeking behavior of astronomers. What we have noticed is mainly studies about scientists in a general context, in which astronomers are included. For example, as Tenopir (2005) mentions, «preferences of physicists are often studied, but astronomers are less often singled out for study».

In 1993, Ellis et al. investigated the information seeking patterns of a group of social scientists, physicists and chemists using the grounded theory approach. The result of this study is the well known Ellis' model of information-seeking behaviour, which is constituted from five features for the information-seeking behaviour of the above mentioned group. The five features were: initial familiarization, chasing, source prioritization, maintaining awareness, and locating, and they were the same for everyone in the group regardless of their area of study.

However, as Hemminger (2007) mentions, «when examining differences between subgroups most researchers have found specific differences. Hurd, Wheeler, and Curtis (1992) found that chemists rely heavily on current journals. Mathematicians make more use of older material based on citation studies (Garfield, 1983). Physicists and astronomers have made more use of preprints due to the development of preprint servers (e.g., arXiv) in their field (Ginsparg, 1994; Taubes, 1993)».

Characteristic example of Hemminger's remark is Brown's (1999) study, who investigated astronomers, chemists, mathematicians, and physicists at the University of Oklahoma. The astronomers of her group, showed differences in their preferences, for example, as far as their visits to the library or the information sources they used is concerned. They made a lot of use of the library, in contrast to mathematicians, and they were more dependent on current journals, as well as on pre-print archives. In general, physicists and astronomers are heavy users of e-print archives (Jamali and Nicholas, 2009), especially of the arXiv.org eprint archive, originally developed by Paul Ginsparg at the Los Alamos National Laboratory (Tenopir, 2005).

One of the most recent studies is that of Jamali and Nicholas (2008). The two researchers examined two aspects of information seeking behaviour of physicists and astronomers including methods applied for keeping up-to-date and methods used for finding articles. They concluded that «there are significant differences among

subfields of physics and astronomy with regard to information-seeking behaviour in terms of their reliance on different methods used for keeping up-to-date as well as methods used for finding articles.»

As we mentioned above, there are not any information seeking behaviour studies with a focus on astronomers, investigating similarities or differences among them according to their main characteristics, as for example, their academic status, research area, age, or affiliated institution. This study aims to fill this gap.

### **Methodology**

The population of our study was restricted to the area of Athens, so we came into contact with the 18 professors of the Department of Physics and Astronomy of the University of Athens, as well as the 41 researchers of the Academy of Athens and of the National Observatory. In our sample we also included the 25 PhD and the 22 MSc students of the University of Athens. The total number of people that constitute our population is 106.

Firstly, thirteen (13) face-to-face semi-structured interviews were conducted. The analysis of these interviews, as well as the study of the corresponding bibliography, helped us to set the online questionnaire, which was filled in by 71 recipients (68.8% response rate).

### **Main results**

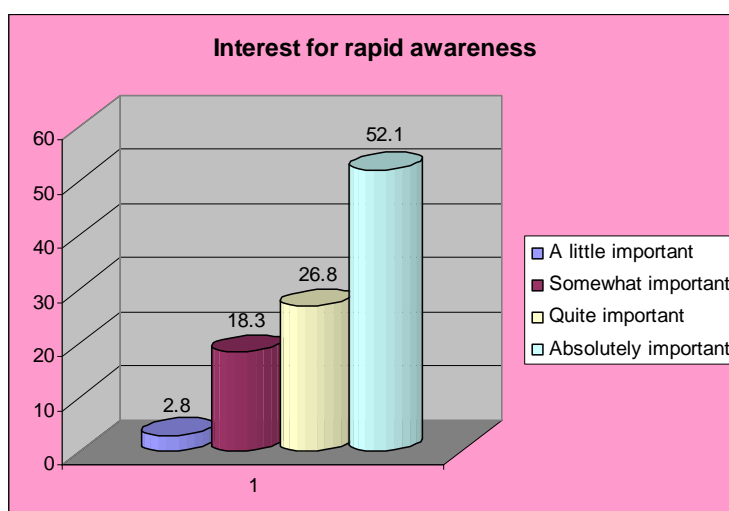
We present our results in three sections using simple descriptive statistics. The three sections are the following: A) Interest in keeping up to date with current developments B) Methods used for keeping up-to-date and C) Information sources usage.

As a general remark we could mention that the MSc students present differences in their behaviour in comparison to the other groups. So, we have conducted the analysis both with and without the answers of that particular group, particularly in the cases we had the feeling that we would come up with distorted results.

#### **A) Interest in keeping up to date with current developments**

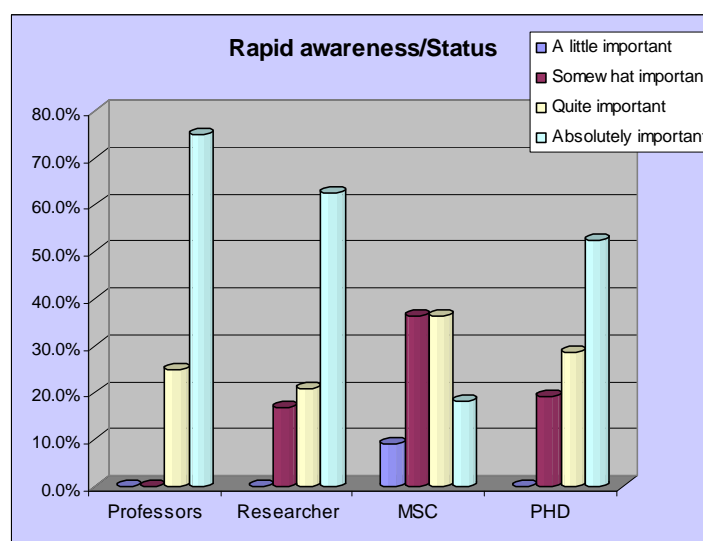
In this section we present the results from the two relative questions we had included in our questionnaire. The first question was: «How important is rapid awareness of new papers for you?». The participants had to choose among the following rate of options (*Not at all important /A little important /Somewhat important /Quite important/ Absolutely important*). The second question was: «How many hours a week do you spend for keeping up with current developments?».

The majority of the respondents to our research, as it might be expected, deem absolutely necessary keeping up-to-date with the latest papers, as 52.1% ticked the option «absolutely important» for the first question. Moreover, nobody (0%) chose the option «not at all important». The rest of the responses to that same question were the following: «a little important» (2.8%), «somewhat important» (18.3%), «quite important» (26.8%).



Graph 1

Further analysis of our results revealed that levels of importance varied depending on the status of the respondents. Professors and researchers show greater interest in keeping in touch with current developments in comparison to PhD and MSc students. «Absolutely important» was the most popular answer among professors (75%), researchers (62.5%) and PhD students (52.4%). MSc students were the only group of which the majority of respondents ticked «somewhat important» (36.4%) and «quite important» (36.4%).



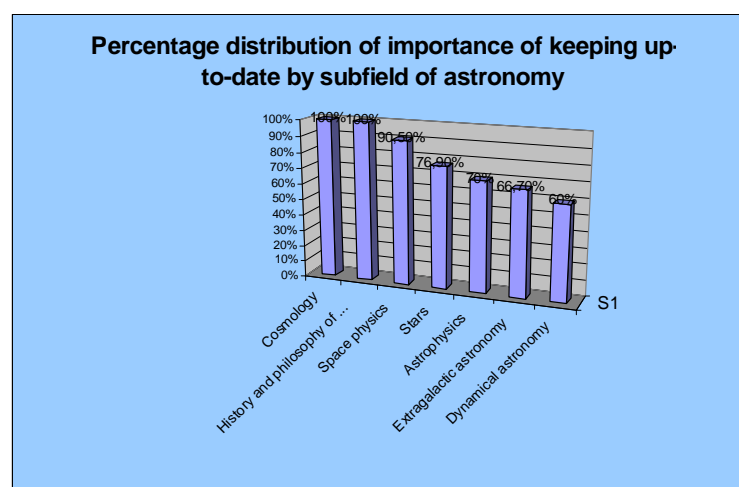
Graph 2

We tried excluding the MSc students from the general results of that question and as a consequence we took different values, with a transposition towards «absolutely important»: «not at all important» (0%), «a little important» (1.6%), «somewhat important» (14.5%), «quite important» (24.2%) and «absolutely important» (59.7%).

Jamali, H.R. and Nicholas, David (2008) had included a relative question in their research. We can have a comparison with our results, although unfortunately they don't give us any data concerning exclusively the astronomers. In their article "Information-seeking behaviour of physicists and astronomers" they mention that «the

majority of their respondents believed that it was important for them to keep up with the developments of their subfields. A quarter of the respondents considered keeping up-to-date as absolutely critical for their research. Fifty-five per cent ticked the option "quite important".... Looking at the academic status of the respondents, it turned out that those who associated less importance with keeping up-to-date were more likely to be PhD students or research fellows.»

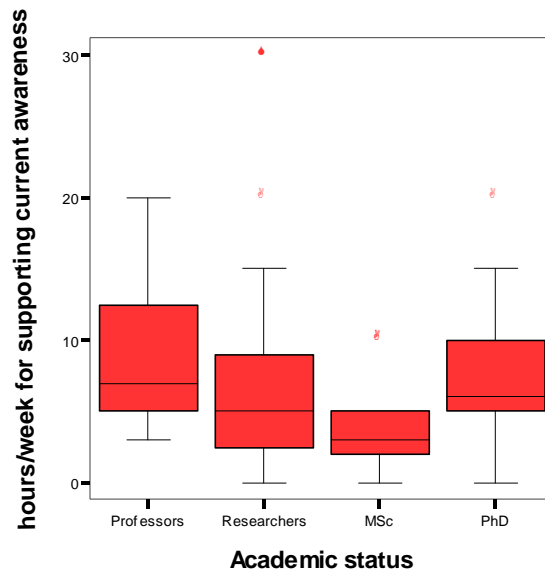
Moreover, levels of importance varied when examining different subfields of astronomy (*graph 3*). 100% of astronomers in the subfields of cosmology as well as history and philosophy of astronomy expressed the view that keeping up-to-date is of quite to absolute importance to them. However, the rest of the participants valued keeping up to date less: that is, 90.5% of participants in space physics, 76.9% in stars, 70% in astrophysics, 66.7% in extragalactic astronomy, and 60% in dynamical astronomy stressed that keeping up to date is of quite to absolute importance.



Graph 3

Statistical manipulation of responses on the second question, i.e. «How many hours a week do you spend for keeping up with current developments?» revealed that astronomers in Greece spend on average 7 hours per week in keeping up to date (median and mode =5, the minimum time they spend = 0 hours, the maximum = 30 hours).

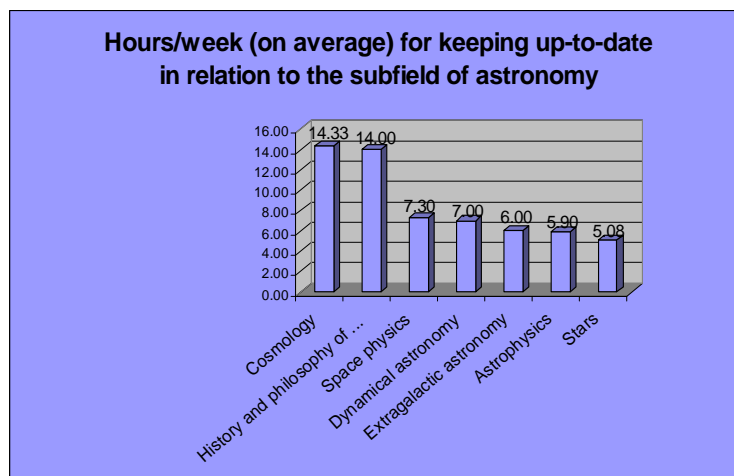
Looking into the amount of hours per week astronomers in Greece spend on average keeping up to date varies according to their status (*boxplot 1*). Specifically, professors spend on average 9 hours per week, that is, more time than any other group. Researchers and PhD students spend 7 hours per week. MSc students present very low rates (Mean = 4 hours/week, mode =2).



Boxplot 1

These findings resemble the results of the former question «How important is rapid awareness of new papers for you?», where we found that professors show greater interest in keeping up with current developments, in comparison to any other group.

The amount of hours per week astronomers in Greece spend on average keeping up to date varies also according to the subfield of astronomy they work on (*graph ...*). Cosmologists spend the most amount of hours keeping up-to date than any other category (Mean =14.33 hours/week). This category is followed by the subfield of History and philosophy of astronomy (Mean =14 hours/week). In the graph below the differences in the time our respondents spend according to their research area are obvious.

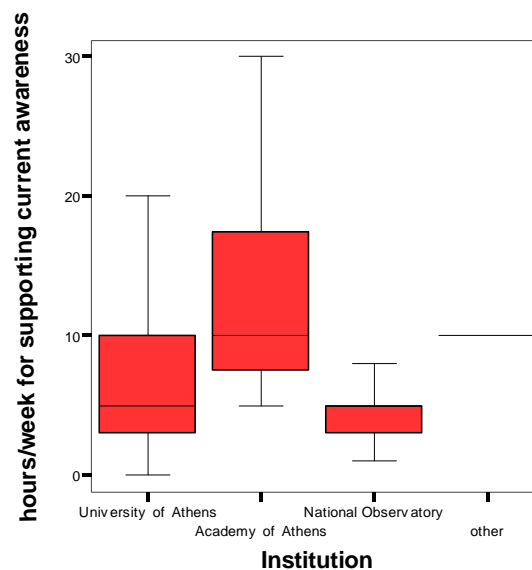


Graph 4

These findings resemble the results of the former question «How important is rapid awareness of new papers for you?», where we found that astronomers in the subfields of Cosmology as well as History and philosophy of astronomy expressed the view

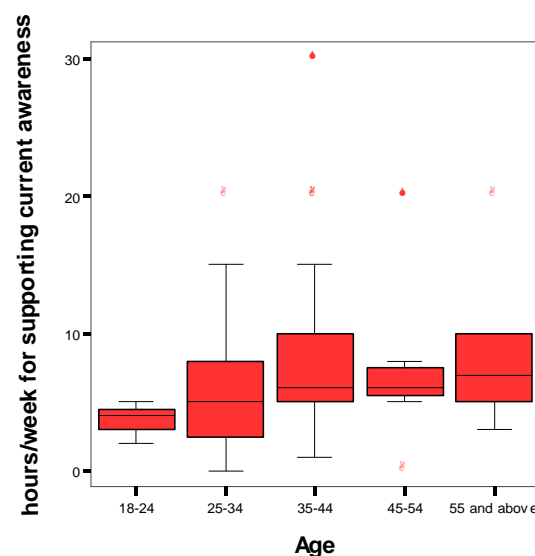
that keeping up-to-date is of quite to absolute importance to them more strongly than any other category.

Differences in the levels of the time spent for keeping up-to-date are observed also among the respondents occupied in different institutions. As the boxplot below shows, researchers of the Academy of Athens dedicate the most time in comparison to the scholars of the other two institutions (Mean =12.82 hours/week, median =10, mode =10). The corresponding values for the University of Athens and the National Observatory are: Mean =6.67 hours/week, median =5, modes =2, 5 and Mean =4.23 hours/week, median =5, mode =5, respectively.



*Boxplot 2*

The following boxplot shows that there are no great differences in keeping up-to-date as far as the various age groups are concerned, except for the groups 18-24 and 25-34 that seem to show lower interest in comparison to the rest.

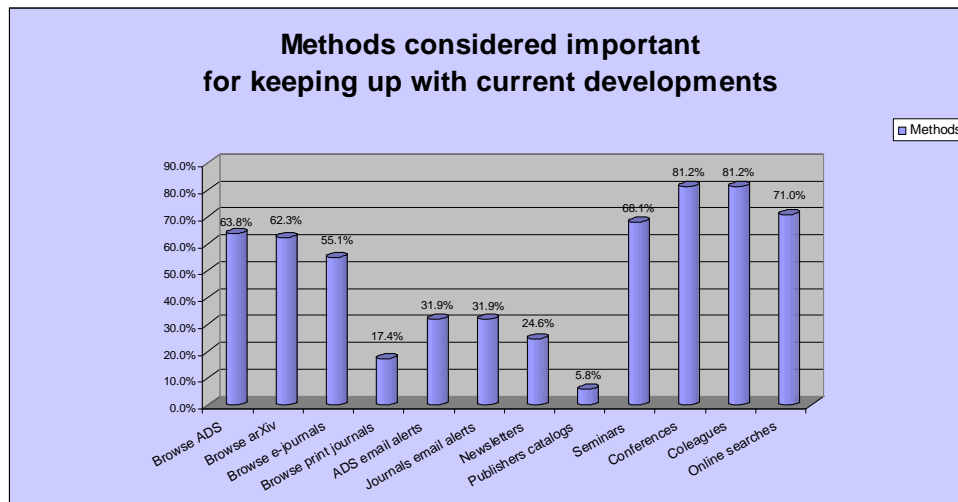


*Boxplot 3*

### **B) Methods used for keeping up-to-date**

In order to investigate this aspect of information seeking behaviour of Greek astronomers we included in our questionnaire the following question: «How dependent are you on each of these methods for keeping up-to-date with current developments?». For each of the cited methods, the respondents had to choose among rated options ranging from «Not at all necessary» to «Absolutely necessary».

For the analysis of this question we used the percentage of the option «Quite necessary» additionally with that of the option «Absolutely necessary». The most popular methods that our respondents rely on for keeping up with the developments in their field are the conferences and their colleagues (*graph ...*). 81.2% of our respondents chose each of these methods in the relevant question. 71% chose the conduct of regular searches on the Internet, and 68.1% the seminars. Lower on this list are the regular browsing of ADS (63.8%), of arXiv (62.3%), and of e-journals (55.1%). It is interesting that the email alerts of ADS are not used heavily (31.9%), as, according to what the interviews showed us, astronomers prefer the regular browsing of the database. The same is true for the email alerts of the e-journals (31.9%). Less necessary are considered by our respondents the newsletters (24.6%), the classic browsing of printed journals (17.4%) and the publishers' catalogs (5.8%).



Graph 5

The analysis of the results respectively to the research area of the participants is of special interest:

- The astronomers in the subfield of Dynamical astronomy don't use so intensely as the other groups the arXiv.org eprint archive, as well as the electronic periodicals for their keeping up-to-date. On the contrary they use more than the others the ADS email alerts. Furthermore, all the participants of this group chose the seminars as the most necessary method for their keeping up-to-date.
- All the participants in the subfield of Cosmology chose the conferences as the most necessary method for their keeping up-to-date. Moreover, they use ADS less than all the others.
- Astrophysicists cling more than all the other groups on ADS, as well as on the discussions with their colleagues following the scholars in the subfield of Extragalactic astronomy, who, in turn don't use any printed journals at all.



- The scholars of the research area of Space physics use more than all the others the email alerts of the e-journals, as well as the ADS email alerts, being second to the scholars of Dynamical astronomy.

We didn't observe remarkable differences as far as the age, the academic status and the institute that our participants are occupied.

### **C) Information sources usage**

In order to investigate this aspect of information seeking behaviour of Greek astronomers we included in our questionnaire the question «How often do you use each of the following information resources for identifying the necessary information you need?». For each of the cited numbered sources, the participants had to choose among the following rate of options: Never/ once or twice a month/ 4-5 times a month/ 2-3 times a week/ Daily.

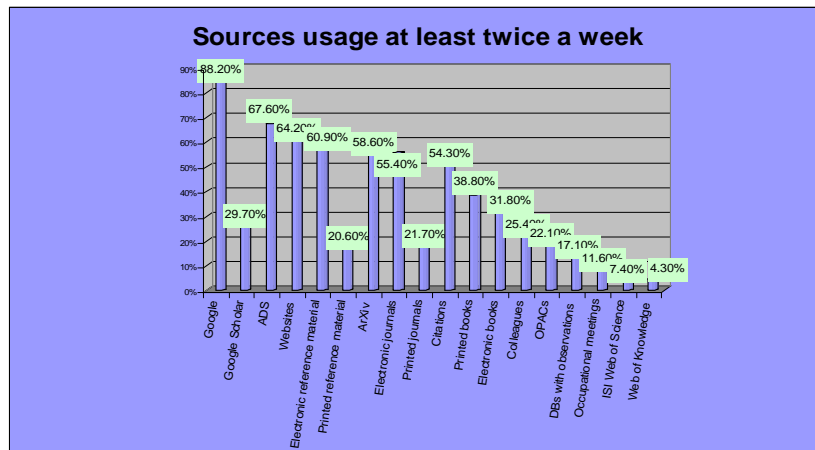
Apart from the answer to this question, we also asked our participants to mark the source (preceded by serial number) they consider primary source of information for their teaching, research, observations, keeping up with current developments, writing of articles, books, etc., personal updating, and their introduction into a subject area not well known. Our goal was to spot any differences in their preferences of sources respectively to their upcoming information needs.

For the analysis of the first question we used the percentage of the option «Daily» additionally with that of the option «2-3 times a week». By analysing the question the results showed that (as it appears in the graph...) the information sources mostly used (at least 2 to 3 times a week) are as follows: Google 88.20%, ADS 67.6%, websites 64.2%, electronic reference material 60.9%, ArXiv 58.6%, e-journals 55.40% and citations 54.3%.

Lower on this list are printed books (38.80%), electronic books (31.80%), Google Scholar (29.70%), colleagues recommendations (25.40%), library catalogs (22.10%), printed journals (21.70%), printed reference material (20.60%), databases for observations (17.10%), occupational meetings (conferences etc) (11.60%), ISI Web of Science (7,40%), and Web of knowledge (4,30%).

The main results concerning the usage of the information sources are the following (*graph 6*):

- ADS and Google is used by everyone in our sample, regardless of the subfield of astronomy our participants work on.
- Google Scholar is not used so often, especially if compared to the use of Google.
- Databases such as “ISI Web of Science” or “Web of Knowledge” are not so popular among the Greek astronomers.
- Wikipedia is being increasingly used.
- The use of printed material as well as of traditional libraries has been limited to a minimum, with the only exception of the printed books that are more popular than e-books.



Graph 6

The main results concerning the usage of the information sources in comparison to the status of the participants are as follows:

- Unlike the majority of astronomers, MSc students don't use ADS neither do they use arXiv.org database heavily, but they use mainly Google, reference material in electronic format and printed books.
- Journals and books in printed format, as well as Google Scholar are used mainly by professors.
- Books in electronic format are used mainly by PhD and MSc students.
- Citations are used heavily by researchers.

Differences were also observed while analyzing the results concerning usage of the information sources by the subfield-research area of the participants:

- The participants in the subfield of Dynamical astronomy don't use arXiv.org database so heavily, in comparison to the participants of the other subfields. Furthermore, Dynamical astronomy and History and philosophy of astronomy scholars use e-journals less often than the rest.
- Cosmologists use ADS less often than everyone. They equally cling on arXiv.org and e-journals as often as they cling on Google.

All of the above findings concerning subfield of Dynamical astronomy and of Cosmology resemble the findings of our former question «How dependent are you on each of these methods for keeping up-to-date with current developments?».

Moreover:

- Databases for observations and printed reference material are mostly used by the subfield of Stars.
- Websites are used less by the subfield of Dynamical astronomy.

The most remarkable results concerning the usage of the information sources in relation to the age of the participants are as follows:

- arXiv.org, as well as electronic library catalogs and electronic books are not used so much by the astronomers of 55 years old and above.
- The same age category uses mostly Google scholar and printed journals.
- The age category 18-24 uses mostly Google, websites, electronic reference material and printed books.

Furthermore, the differences among our participants concerning the usage of information sources in relation to their information needs, their academic status and the institute they are occupied are of special interest:

- Databases for observations (35.4%), as well as ADS (22.9%) were the tools of choice for all of our participants for support of observations data gathering. PhD students, in contrast to the other groups, indicated ADS (37.5%) to be the primary source for the same purpose. ADS database was chosen mainly by the University of Athens (90.9%). Researchers of the National Observatory (33.3%) chose Databases for observations (43.8%) and Websites (25%).
- For support of their research all of our participants indicated ADS (54.8%), arXiv.org (11.3%) and e-journals (9.7%) as primary sources of information. E-journals were chosen mainly by the PhD students.
- In order to keep abreast with current developments in their field the most important sources are arXiv.org (22%) and ADS (15.3%).
- For support of their teaching the participants chose arXiv.org (19.6%), websites (15.7%) and printed books (13.7%). 44% of professors chose arXiv.org in this question. Researchers of the National Observatory chose Google and printed books. Researchers of the Academy of Athens chose mainly Google.
- In order to discover information for writing books, articles etc. our participants use mainly ADS (39.3%), arXiv and Web of knowledge (9.8%), but also electronic library catalogs and e-journals (8.2%).
  - We tried excluding the MSc students from the general results of that question and as a consequence we took the following different values: ADS (43.6%), arXiv (10.9%), e-journals (9.1%), electronic library catalogues, websites and Web of knowledge (7.3%).
- For support of their personal information needs, websites (20%) and Google (18.3%) were mainly chosen. Lower on this list are arXiv.org (13.3%) and electronic reference material (8.3%). Electronic reference material is used only by researchers and PhD students.
  - When excluding MSc students our results are formed as follows: Google (19.6%), websites (17.6%), arXiv.org (11.8%) and electronic reference material (9.8%).
- Finally, in order to cover their investigation needs for a subject area not well known, our participants chose as the most important sources of information electronic reference material (24.6%), websites (19.7%) and then printed books, as well as ADS (8.2%). Printed books were chosen mainly by researchers of the Academy of Athens, and websites by PhD students.

## **Conclusions**

The main aim of our study was the investigation of similarities and differences in information seeking behaviour among astronomers in Greece when examining them as groups with different characteristics, such as academic status, subfield-research area of astronomy, age, and affiliated institution. The analysis of our results showed that although some similarities exist, each of the above group has its own characteristics. This was confirmed through the analysis of all of the three aspects of

information seeking behaviour we examined, that is a) the importance they place in keeping up-to-date with current developments b) the methods they depend on for keeping up-to-date and c) the information sources they mostly use.

For example, the majority of the respondents deem absolutely necessary keeping up with current developments. Complementary to that, and as far as the methods participants use for keeping up to date is concerned, there is high reliance on resources entailing human contact (e.g. seminars, colleagues, etc.) and informal communication. But, although there are such similarities, the levels of importance and of reliance varied depending on their status, research area, age, or affiliated institution.

Furthermore, as it happens with their colleagues from foreign countries, the astronomers in Greece highlight ADS (Astrophysics Data System) as their primary source of information. ADS is the well known NASA supported bibliographic database, which covers all the important literature for astronomers, and is freely available on the Web. In addition, everyone shows a preference to electronic sources of information versus the printed ones. But although there are general tendencies as far as the information sources usage is concerned, a lot of variations were observed when examining our participants as groups with different characteristics.

Concluding, our work revealed the need for deeper investigation of narrower subject communities within disciplines in order to acquire deeper understanding of the information seeking behavior of the users we study.

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